Supplementary Information (SI) for Environmental Science: Nano.

Hollow Co_3O_4 nanospheres modified with $RuCl_3$ as peroxidase mimics for sensitive determination of sulfide ions at neutral pH

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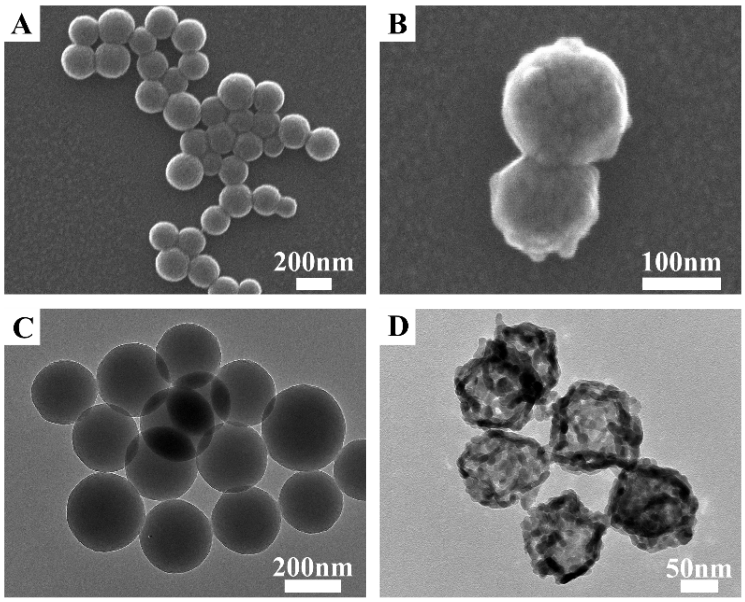

Fig. S1. (A) SEM and (C) TEM images of carbon nanospheres. (B) SEM and (D) TEM images of Co_3O_4 HNSs.

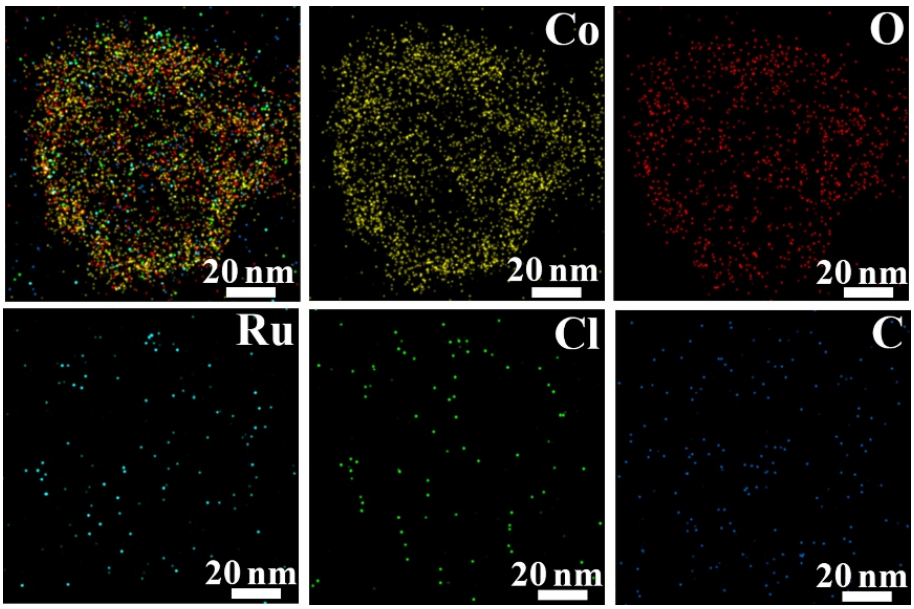

Fig. S2. EDX elements mapping of Ru^{3+}-Co_3O_4 HNSs.

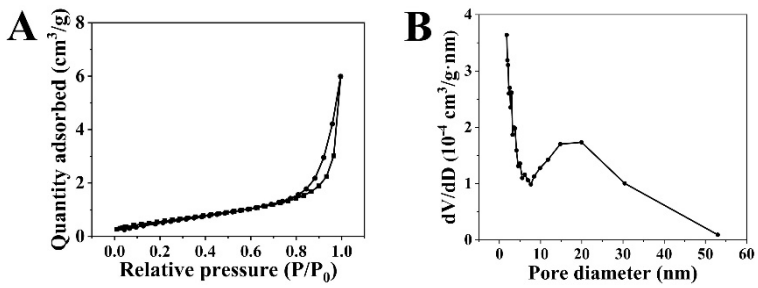

Fig. S3. (A) N_2 adsorption-desorption isotherms of Co_3O_4. (B) Corresponding pore size distributions.

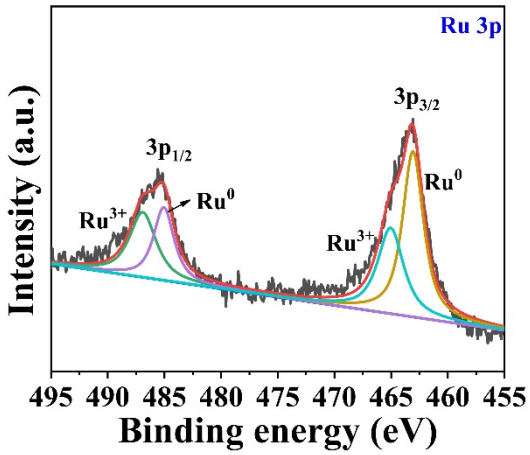

Fig. S4. The high resolution XPS detailed spectra of Ru 3p of Ru^{3+}-Co_3O_4 HNSs.

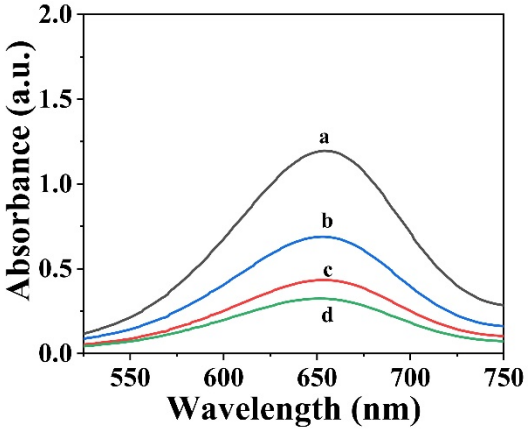

Fig. S5. UV-vis absorbance spectra of different reaction systems. a: TMB+H_2O_2+Ru^{3+}-Co_3O_4 for 5 min, b: TMB+H_2O_2+Ru^{3+}-Co_3O_4 for 5 min then removing Ru^{3+}-Co_3O_4 and adding S^{2-}, c: TMB+H_2O_2+Ru^{3+}-Co_3O_4 for 5 min then adding S^{2-}, d: Ru^{3+}-Co_3O_4+S^{2-} for 5 min then adding TMB+H_2O_2.

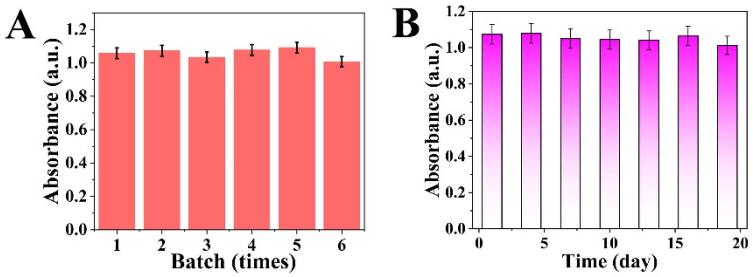

Fig. S6. (A) Reproducibility and (B) stability of Ru^{3+}-Co_3O_4 HNSs.

Table S1. EDX element contents of Ru^{3+}-Co_3O_4.

Element	Family	Atomic Fraction (%)	Atomic Error (%)	Mass Fraction (%)	Mass Error (%)	Fit error (%)
C	K	13.16	2.55	4.57	0.57	6.43
O	K	42.28	11.47	19.56	4.45	1.94
Cl	K	0.8	0.26	0.82	0.24	19.59
Co	K	43.38	9.81	73.94	12.62	0.77
Ru	L	0.38	0.11	1.11	0.27	18.55

Table S2. The optimum pH value of S^{2-} was detected by different nanozymes.

Catalyst	Optimum pH value	Ref.
$CuCo_2O_4$ NWs	4.0	1
ZnS NPs	4.0	2
$FePPOP_{EPA}$	3.39	3
Ag-Fe_3O_4	3.5	4
SnTe	4.0	5
GBR	4.48	6
Fe-PPOP	3.6	7
Ru^{3+}-Co_3O_4 HNSs	**7**	**This work**

Table S3. Comparison of the apparent Michaelis constant (K_m).

Catalyst	K_m/mM		Ref.
	TMB	H_2O_2	

HRP	0.43	1.21	8
Mo-CQDs	0.38	0.05	9
Ru NPs	0.234	2.206	10
$Pt/CuCo_2O_4$	0.24	0.41	1
NGZF	0.907	115.52	11
Ru^{3+}-Co_3O_4 HNSs	**0.39**	**0.25**	**This work**

Table S4. Comparison of different nanozymes for the colorimetric detection of S^{2-} ions.

Material	Linear range (μM)	LOD (nM)	Ref.
βFeOOH	5-30	2190	12
Au@Ag	1.5-10	500	13
$Pt/CuCo_2O_4$	0.5-10	85.9	1
Ag	0.8-6.4	350	14
Carrageenan-Silver	2.5-1000	1700	15
SA Fe/B-g-C_3N_4	1-10	570	16
GMP-Cu	2-220	670	17
Ru^{3+}-Co_3O_4 HNSs	**0.5-20**	**51**	**This work**

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